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(54) Complex oxide having high thermoelectric conversion efficiency

(57) This invention provides a complex oxide comprising the features of : (i) being represented by the formula: $(A_{0.4}B_{0.1}M_{0.1})_{x/0.6}Co_2O_y$, wherein A and B are elements differing from each other, each represents Ca, Sr or Ba, M represents Bi, Sc, Y, La, Ce, Pr, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Yb or Lu, $1.7 \leq x \leq 2$, and $3.8 \leq y \leq 5$, (ii) having a Seebeck coefficient of 100 $\mu\text{V/K}$ or more at a temperature of 100 K (absolute temperature) or higher and (iii) having an electrical resistivity of 10 $\text{m}\Omega\text{cm}$ or

less at a temperature of 100 K (absolute temperature) or higher. The complex oxide of the invention is a material composed of low-toxicity elements existing in large amounts, the material having superior heat resistance and chemical durability and a high thermoelectric conversion efficiency in a temperature range of 600 K or higher which falls in the temperature range of waste heat.



DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
P, X	FUNAHASHI R ET AL: "AN OXIDE SINGLE CRYSTAL WITH HIGH THERMOELECTRIC PERFORMANCE IN AIR" JAPANESE JOURNAL OF APPLIED PHYSICS, JAPAN SOCIETY OF APPLIED PHYSICS, TOKYO, JP, vol. 39, no. 11B, PART 2, 15 November 2000 (2000-11-15), pages L1127-L1129, XP001020524 ISSN: 0021-4922 * the whole document * -----	1-4	H01L35/14 H01L35/18
A	FUNAHASHI RYOJI ET AL: "Thermoelectric properties of Bi ₂ Sr ₂ Co ₂ x polycrystalline materials" APPLIED PHYSICS LETTERS, AIP, AMERICAN INSTITUTE OF PHYSICS, MELVILLE, NY, US, vol. 76, no. 17, 24 April 2000 (2000-04-24), pages 2385-2387, XP012025125 ISSN: 0003-6951 * the whole document * -----	1-4	
A	LI S ET AL: "High temperature thermoelectric properties of oxide Ca ₉ Co ₁₂ O ₂₈ " EIGHTEENTH INTERNATIONAL CONFERENCE ON THERMOELECTRICS. PROCEEDINGS, ICT'99 (CAT. NO.99TH8407) IEEE PISCATAWAY, NJ, USA, 1999, pages 581-583, XP002372162 ISBN: 0-7803-5451-6 * the whole document * ----- -/-	1-4	H01L TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
1	Place of search The Hague	Date of completion of the search 15 March 2006	Examiner Kirkwood, J
CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document			



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A	<p>TERASAKI I ET AL: "Large thermopower in a layered oxide NaCo₂O₄" SEVENTEENTH INTERNATIONAL CONFERENCE ON THERMOELECTRICS. PROCEEDINGS ICT98 (CAT. NO.98TH8365) IEEE PISCATAWAY, NJ, USA, 1998, pages 567-569, XP002372276 ISBN: 0-7803-4907-5 * the whole document *</p> <p>-----</p>	1-4										
P,A	<p>LI S ET AL: "THERMOELECTRIC PROPERTIES OF OXIDES Ca₂Co₂O₅ WITH Bi SUBSTITUTION" JOURNAL OF MATERIALS SCIENCE LETTERS, CHAPMAN AND HALL LTD. LONDON, GB, vol. 19, no. 15, 1 August 2000 (2000-08-01), pages 1339-1341, XP001005197 ISSN: 0261-8028 * the whole document *</p> <p>-----</p>	1-4										
			TECHNICAL FIELDS SEARCHED (IPC)									
1	<p>The present search report has been drawn up for all claims</p> <table border="1"> <tr> <td>Place of search The Hague</td> <td>Date of completion of the search 15 March 2006</td> <td>Examiner Kirkwood, J</td> </tr> <tr> <td colspan="2">CATEGORY OF CITED DOCUMENTS</td> <td> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> <tr> <td colspan="2"> X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> <td></td> </tr> </table>			Place of search The Hague	Date of completion of the search 15 March 2006	Examiner Kirkwood, J	CATEGORY OF CITED DOCUMENTS		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		
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